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Research Article

Normalized Difference Vegetation Index of Banana Crop as Influenced by Various Colour Plastic Mulches

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ABSTRACT

The research was conducted to study the effect of six coloured plastic mulches along with no mulch treatment on Normalized Difference Vegetation Index (NDVI) values of banana crop at MPKV, Rahuri, Maharashtra, India. The plastic mulches were yellow, blue, silver, white, red and pervious plastic mulches. All the seven treatments were given irrigation with 48% of pan evaporation. The results indicated that, highest NDVI value (0.894) observed in plants under pervious plastic mulch, followed by that (0.891) in silver black plastic mulch at 300 days after transplanting due to greater density of vegetation. The minimum NDVI value (0.810) at 300 days after transplanting was observed in plants under no mulch treatment. NDVI values in all treatments increased continuously during peak growth period of banana crop and decreased slightly in the harvesting stage of the crop. This may be due to reason that, the banana crop remained green or healthy in the harvesting stage also.

Keywords: *Banana, mulch, Normalized Difference Vegetation Index (NDVI)*

INTRODUCTION

Mulch is any material laid on the soil in order to provide favorable environment for growth of plant and conservation of moisture (Ahmed et al., 2010). The greater marketable yield is observed with the use of plastic mulches (upto 24 to 65% increase) compared to bare soil, which is because of conservation of moisture, improved micro climate both beneath and above the soil surface, light reflection and great weed control (Agrawal & Agrawal, 2005). The different colour mulches like yellow, grey, blue reflect different radiation patterns back into the canopies of various crops affect plant growth and development in many ways (Ashrafuzzaman & Halim, 2011). Therefore, different crops responds differently to specific colour of mulch. Hence there is need to adopt specific colour mulch for particular crop.

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Banana (*Musa paradisica* L.) is the fourth most important food crop in the world after rice, wheat and maize with a world production of around 80 million metric tonnes in 2006. In the world India is the largest producer of banana with an annual production of 23.205 million metric tonnes from an area of 0.647 million ha (Rajablariani et al., 2012). The cycle time of Grandnaine variety of banana is slightly shorter, bunches are slightly heavier and fingers slightly longer. The state of the land vegetative condition can be explained with the help of vegetative parameters such as Normalized Difference Vegetative Index (NDVI) (Csizinszky et al., 1995). NDVI is a numerical indicator that uses the visible and near-infrared bands of the electromagnetic spectrum, and is adopted to analyse remote sensing measurements and assess whether the target being observed contains live green vegetation or not (Decoteau et al., 1990). The NDVI values ranges from -1 to +1 (pixel values 0 to 255). NDVI values vary with leaf characteristics (Goenaga & Irizarry, 1998). The present study is aimed to find NDVI values for banana crop at its different growth stages and under different colour mulches using the spectroradiometer.

MATERIALS AND METHODS

The field experiment was carried out at the Research cum Demonstration Farm of Precision Farming Development Centre (PFDC), Dr. Annasaheb Shinde College of Agricultural Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri during the period from December, 2014 to December, 2015. The field experiment was laid out in a randomised block design, which comprised of seven treatments with three replications. The dimensions of individual treatment plot were 7 x 3.5 m with 0.30 m height. The mulches used for different treatments were 30 micron in thickness, 7.5 m in length and 2.1 m in width. The soil of the experimental field was clay type. The field capacity, permanent wilting point, bulk density was 40.09%, 17.37% and 1.24 gm cm^{-3}, respectively.

The treatment details are given as below:

T_1 = Yellow black plastic mulch with daily drip irrigation at the rate of 48% pan evaporation

T_2 = Blue black plastic mulch with daily drip irrigation at the rate of 48% pan evaporation

T_3 = Silver black plastic mulch with daily drip irrigation at the rate of 48% pan evaporation

T_4 = White black plastic mulch with daily drip irrigation at the rate of 48% pan evaporation

T_5 = Red black plastic mulch with daily drip irrigation at the rate of 48% pan evaporation

T_6 = Pervious black plastic mulch with daily drip irrigation at the rate of 48% pan evaporation

T_7 = No mulch with daily drip irrigation at the rate of 48% pan evaporation

All treatment were given daily drip irrigation with 48% of pan evaporation. This was based on recommendation of irrigation by PFDC, MPKV, Rahuri for banana crop as 60% of pan evaporation, which was for non-mulched treatment. Thus, considering average water saving of mulch as 20%, drip irrigation was scheduled as 48% of pan evaporation for mulched treatments. The spectroradiometer used in the present study was HR 1024 developed by the SVC i.e. Spectra Vista Corporation. This spectroradiometer is capable of measuring the spectrum of different light sources reflected from the target 350 nm to 2500 nm. The data recorded at the time of field measurements was stored in the form of ASCII file in PDA provided with instrument. The data stored at time of field measurement was then transferred to computer for further processing in 32-bit data processing software of HR 1024. The overlay matching of data was performed and data was exported to excel sheet. NDVI values were calculated using the formula given by equation (1) (Daughtry et al., 1992).

$$\text{NDVI} = \frac{\text{Near Infrared band} - \text{Red band}}{\text{Near Infrared band} + \text{Red band}} \quad \ldots.(1)$$

Near infrared band ranges from 700 nm to 1300 nm and red band ranges from 620 nm to 699 nm. By averaging the values of reflectance observed, the NDVI value of the week for particular treatment was calculated. During the field operation the spectral signature were recorded on weekly basis after the irrigation was given. But for the use of NDVI values in computer model and decision support system and better planning, management of irrigation water, daily values of NDVI are required.

RESULTS AND DISCUSSION

Variation in NDVI values of banana crop:

Greater the amount of healthy green vegetation in the field of view of the sensor, the greater the NDVI value (Hangbin et al., 2011). This relationship is deduced from the physiological fact that chlorophyll a and b in the palisade layer of healthy green leaves absorbs most of the incident red radiant flux while the spongy mesophyll leaf layer reflects much of the near infrared radiant flux (Johnson, & Thomas, 2012). This fact is also seen in the NDVI values recorded. In the vegetative and flowering stage, there is more amount of healthy vegetation present.

The maximum NDVI value (0.8943) recorded in plants under pervious plastic mulch at 300 DAT, followed by that in plants under silver black plastic mulch (0.8918) and white black plastic mulch (0.8765), respectively. Photosynthetically active radiation (PAR) for these treatments was maximum as compared to other treatments; thus due to denser green canopy, NDVI values recorded for these treatments were maximum. The minimum NDVI value (0.8323) at 300 DAT was recorded in plants under no mulch treatment. The variation in NDVI values is graphically shown in Fig. 1. Such results were also reported by Kadam (Kadam, 2014).

Absorbed Photosynthetically Active Radiation (APAR):

The highest Absorbed Photosynthetically Active Radiations (APAR) were observed in plants under silver black plastic mulch at 240 DAT ,followed by plants under white black plastic mulch and minimum in no mulch treatment. APAR increased continuously upto 240 DAT and then decreased. The periodical data on APAR is given in Table 1.

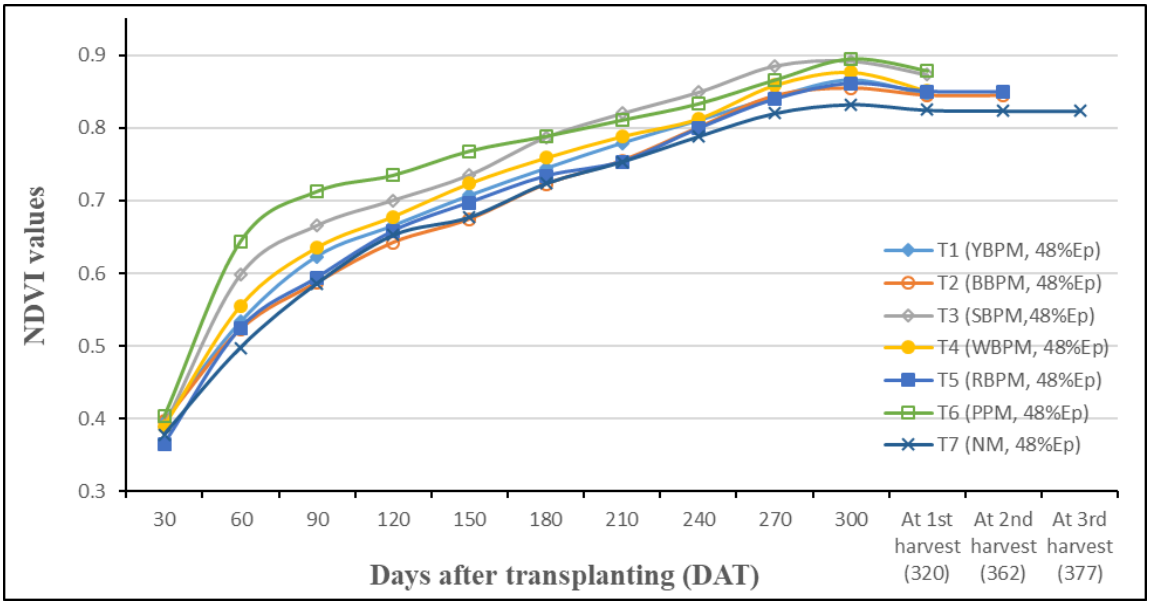

Fig. 1: NDVI values of banana crop as influenced by various treatments

Table 1. Absorbed Photosynthetically Active Radiations of banana crop as influenced periodically by different treatments

Treatments	Photosynthetically active radiation (µmol m^{-2} s^{-1})					
	60 DAT	120 DAT	180 DAT	240 DAT	300 DAT	At harvest
T_1 (YBPM, 48% Ep)	295.09	483.43	827.60	1025.27	946.32	891.35
T_2 (BBPM, 48% Ep)	196.72	328.85	699.75	931.80	932.56	846.65
T_3 (SBPM, 48% Ep)	307.67	573.25	882.50	1060.78	975.55	900.27
T_4 (WBPM, 48% Ep)	295.62	511.71	866.00	1040.47	972.37	895.17
T_5 (RBPM, 48% Ep)	216.08	353.77	727.73	926.17	935.39	864.61
T_6 (PPM, 48% Ep)	192.25	314.35	655.35	876.00	897.19	842.37
T_7 (NM, 48% Ep)	177.67	290.65	614.50	855.51	864.15	800.53
S.E.m±	12.36	12.63	18.89	24.60	23.41	21.42
C.D. at 5%	37.07	37.88	56.63	73.76	70.17	64.20

CONCLUSION

The NDVI values of banana crop in plants under silver black plastic mulch were in the range of 0.3895 to 0.8918 during the growth period of 323 days. The NDVI value of 0.3895 in initial stage of banana increased to 0.8918 in peak growth stage and again it slightly decreased to 0.8727 in harvesting stage of banana. It was concluded that, the NDVI values in all treatments increased continuously during peak growth period of banana crop and decreased slightly in the harvesting stage of the crop. This may be due to reason that, the banana crop remained green or healthy in the harvesting stage also.

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